CHANNEL PLATE AND MANUFACTURING METHOD THEREOF

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a channel plate used for an image intensifier, a photoelectron amplifier and so on and a manufacturing method thereof.

Related Background Art

An electron multiplier using a secondary electron emission phenomenon, such as a photomultiplier, is widely in the actual use. The electron multiplier has a mechanism having a channel comprised of an interior wall of a glass pipe or a ceramic pipe, wherein an electron accelerated by an electric field is collided against the surface of the wall of the channel to generate a plurality of secondary electrons. Such electron multipliers are made in micro-size and integrated in a high density so as to form a channel plate of a planar structure (also called a multi-channel plate, micro-channel plate and so on), which is used for an image device such as an image intensifier. In recent years, as requirements for the image device, not only more higher level of performance such as higher density, higher sensitivity, higher-speed operation and wider dynamic range, but also larger a size design more than the micro-size and a simple production method in order to provide a device with

larger area and higher resolution. For that purpose, a large channel plate wherein electron multipliers are integrated in a density higher than the micro-size is required.

For higher resolution of channel plate, it is necessary to integrate individual electron multiplier in a high density. For that purpose, it is desired that channel wall thickness to each channel opening is small. Moreover, a plate having a stable channel wall hardly destructible over large area is required for a large-size channel plate that is larger than the micro-size.

The conventional electron multiplier uses glass such as lead glass and ceramics because of the necessity to form a tubular internal wall surface. The conventional multi-channel plate is formed by extending bundled glass pipes in a heated and softened state to form a plate having many pipes, or as shown in Japanese Patent Application Laid-Open No. 2000-113851, or, it is formed by coating a wire surface with diamond film, adhering the coated wire with an insulating substrate such as a plurality of adhesives, cutting the insulating substrate into plate-like elements, removing the wire by etching to form electrodes on both sides of the plate-like element respectively, or as shown in Japanese Patent Application Laid-Open No. 4-87247, it is formed by forming a pipe on a high lead glass

substrate by etching and then heat-treating it in reducing gas atmosphere such as hydrogen.

FIG. 5 is a perspective view illustration showing configuration of the conventional channel plate. On a glass insulating substrate 21, a plurality of channels 22 are formed by etching, and a cathode electrode 24 and an anode electrode not shown therein are formed.

As for the conventional channel plate formed by using glass, it is necessary to decrease a diameter of the channel opening such that the diameter is smaller than the channel wall thickness in order to enhance strength of the glass to be the substrate. Accordingly, it is possible to make it larger but there is a limit to making it higher-resolution in the case of using a glass substrate as the substrate.

In addition, while the method of forming pores by cutting glass pipes or wires after bundling them in an adhesive layer and etching them is suitable for rendering a small plate higher-resolution, it is necessary to enhance adhesive strength against the etching for the purpose to allow the larger area design. Accordingly, the area occupied by the adhesive layer in the pore opening must be large enough. Moreover, in these methods, a semiconductor layer may be formed by heating the channel internal wall glass surface at high temperature in reducing atmosphere such as hydrogen. In such cases, a problem of heat strains